REMARKS/ARGUMENTS

The rejection of Claims 1-5 and 7 under 35 USC 103(a) as being unpatentable over Tanabe in view of Akahira, is being maintained.

Tanabe is cited to show the use of a UV setting ink in the inventive method.

The Examiner relies on an interpretation of a portion in column 12 lines 57-67 of Akahira as evidence that Akahira teaches the use of less than 1ppm oxygen will improve ink discharge stability and therefore render it obvious to use this limitation in the ink of Tanabe.

It is submitted that combining this teaching of Akahira, in the context of the ink of Tanabe is not obvious.

Akahira does not teach the use of low oxygen content to solve the problem of hardening a UV setting ink. Akahira uses a water based ink. As explained in column 13, reduced dissolved oxygen is to prevent bubbles from forming in the type of ink used. When the bubble type ink-jet is heated, bubbles in the chamber expand and interfere with the jetting. To avoid this, Akahira teaches, not that a certain level of oxygen is good, rather Akahira teaches that one should eliminate all oxygen and that the oxygen levels present can be dealt with as described

e.g. at Col. 13, lines 15-26 and Col. 13, lines 15-26 and Col. 13, lines 39-46. The only resin is with respect to the filter. At column 8, lines 50-65 of Akahira, the processes to form a color filter are explained with reference to Figs. 4A to 4F. This process uses a UV curable resin. At lines 52-55 it clearly states reference to a curable resin composition which can be set by irritation. This is not a disclosure of UV curable ink.

As shown in Figs. 4A to 4F, and described in column 8, coated on a substrate 1 is a resin layer 3 which is set by irradiation of light, see column 8, lines 22-24. The resin layer 3 is partially irradiated with light through a photomask 4 so as to form uncolored portion. Several portions of the resin layer 3 are not irradiated with the light so as to form a plurality of cells as ink receiving portions. The plurality of cells are colored with ink jetted from the ink-jet head as shown in Fig. 4d.

Therefore, in Akahira, the light settable material or light curable material is a resin layer and is not ink.

This is further supported by Akahira which teaches that ink is dried in accordance with necessity, see column 8, lines 39-40, and Akahira teaches nothing about a process to irradiate ink with light. Nothing in Akahira would make it obvious to

optimize oxygen in a range for an advantageous results e.g. to avoid hardening UV ink on the ink-jet head as explained below. Rather, the elimination of oxygen is desirable and, how to deal with the disadvantages of its presence, is described.

The present invention, as explained in the last response, solves a problem inherent in UV setting ink-jet ink. In particular, as earlier explained, the UV-setting ink-jet ink of the present invention comprises color materials, UV-polymeric compound containing a radical polymeric compound, and photo-induced polymerization initiator in a water-based medium, wherein a concentration of oxygen dissolved in the ink is 0.1 to 2 ppm at 25°C.

The problem to be solved is that the radical polymeric compound has a very high reactivity so that when the UV-setting ink-jet ink is jetted on a recording sheet so as to form an ink droplet and the droplet is irradiated with UV rays, polymerization in the droplet is started with the work of the photo-induced polymerization initiator, and then the polymerization is conducted rapidly with the work of the radical polymeric compound, thereby the droplet is hardened rapidly.

However, when an ink droplet adheres on a nozzle surface after jetting, the above polymerization takes place in the

adhered ink droplet due to UV rays leaking from a UV light source to irradiate a recording sheet. As a result, the adhered ink droplet is hardened, and then the hardened ink droplet on the nozzle surface causes irregular ink jetting from the nozzle. Especially, the above unnecessary and unwanted polymerization easily takes place when the UV-polymeric compound contains the radical polymeric compound. This is not a problem corresponding to problems inherent in Akahira.

To avoid the unnecessary polymerization problem, in the UV-setting ink-jet ink of the present invention, the ink contains oxygen in an amount of 0.1 to 2 ppm at 25°C. In other words, the inventor's invention is based on the discovery that a predetermined amount of dissolved oxygen can prevent or inhibit the undesired polymerization (page 7 lines 1-7) to give stable ejection performance for the ink-jetting.

Concerning the rejection of Claims 1-5 & 7 under 35 USC 103(a) as being unpatentable over a combination of Tanabe et al and Akahira, as stated in the rejection:

The Examiner admits that Tanabe differs from the claim of the present invention in that there is no teaching to limit the concentration of oxygen dissolved in the ink to 0.1 to 2 ppm at 25°C. To bridge this gap the Examiner asserts that

Akahira teaches that to improve the ink discharge stability, the amount of oxygen dissolved in the ink should be less than 1 ppm.

However, as detailed above, Akahira merely teaches a technique to jet ink onto an ink absorbing resin layer wherein the ink absorbing layer is capable of being set by irradiation of light, see column 8, lines 19 to 40. With regard to the ink, Akahira merely teaches on column 8, lines 49-51 that as the ink used for coloring, dyes and pigment are available, and further, both liquid ink and solid ink are available. With respect to the problem of bubble formation, this is caused by the oxygen in the ink of Akahira. The oxygen content is not present to solve a problem, it is the problem.

From the above teachings, Akahira teaches nothing about the UV-setting ink-jet ink of the present invention or of Tanabe. Tanabe uses a photopolymerizing ink (e.g. see ABSTRACT). It is therefore submitted that it is not obvious to combine the Tanabe teaching with Akahira with respect to non-analogous problems related to the different types of ink. Furthermore, the combination cannot render the present invention obvious.

Therefore, the technique of the present invention to

have the ink contain oxygen in an amount of 0.1 ppm to 2 ppm in order to reduce or inhibit polymerization of ink would not have been obvious over Akahira alone or in combination with Tanabe.

As described in pages 15-16 of the present application, comparative tests were conducted for 3 inks having concentrations of oxygen dissolved in ink of 0.6 ppm, 0.08ppm, and 8.5 ppm respectively.

In the ink having concentrations of oxygen dissolved in ink of 0.08 ppm, after a 2-hour continuous recording, some of ink-jet nozzles were bent and blocked. Akahira would expect such ink to be advantageous because of the low oxygen content. Solid or gummy ink residues were found on the ink jet nozzle plate.

In the ink having concentrations of oxygen dissolved in ink of 8.5 ppm, after a 2-hour continuous recording, ink jet were not conducted properly due to cavitations.

In contrast, in the ink having concentrations of oxygen dissolved in ink of 0.6 ppm, after a 2-hour continuous recording, inks were jetted out successfully even after such a long continuous recording.

The unexpected results according to the invention, discussed above, would not have been obvious, even if taking

Tanabe and Akahira in combination.

In view of the above, the rejections are avoided. Allowance of the application is therefore respectfully requested.

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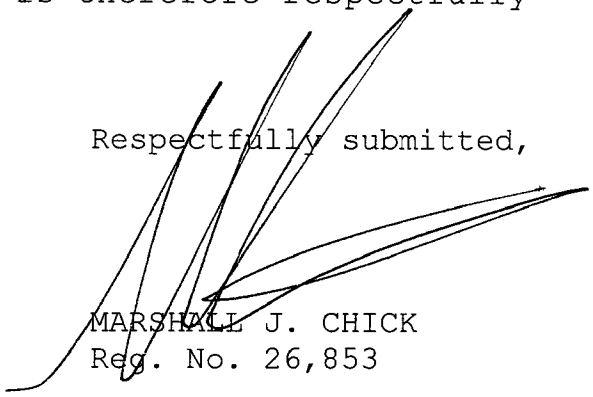
Respectfully submitted,



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